



NATIONAL OPEN UNIVERSITY OF NIGERIA

SCHOOL OF AGRICULTURAL SCIENCE

COURSE CODE: CRP509

COURSE TITLE: ORGANIC CROP PRODCUTION SYSTEMS

Course Developer: Dr. G. L. Luka

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INTRODUCTION

Organic crop production systems is a 2 credit unit course undertaken by 500level students of Bachelor of Science (B.Sc) degree (Crop production programme). The course consists of 10 modules and 23units. This course guide gives you an idea of what the course is about and to work through the units. The course guide helps give an idea of the time likely to be spent on each unit in order to teach it adequately. it serves also as a guide on tutor marked assignments.

WHAT YOU WILL LEARN IN THIS COURSE

This course will help you to understand the concept and principles of organic agriculture as a system devoid of chemical usage in crop production to ensure a healthy environment for man and other living organisms. The course provides you with knowledge of how to use natural resources e.g. manures from animals for soil fertility improvement, plant extracts for pest and disease control and other cultural practices rather than chemicals in the cropping system.

COURSE AIMS

The course is aimed at acquainting you with the basic principles or practices carried in organic crop production without using chemicals thus ensuring a healthy environment and biodiversity conservation. Some of which are

- Maintaining soil fertility using manures, mulches, crop rotations.
- Adopting resistant varieties and rotations as insect and disease management measures.
- Weed management through mechanical or cultural measures rather than using herbicides

COURSE OBJECTIVES

There are stated objectives in each unit of this course which will guide you to remain within the confines of the knowledge you are expected to acquire regarding organic crop production systems. By achieving the stated objectives, the aims of the course are also achieved. The objectives are as follows:

- Definition Soil conservation in organic crop system
- know some practices/ what can destroy soil
- Know the importance of Soil conservation in organic crop system
- To know the basic practices used as soil conservation measures
- To conserve soil moisture
- To prevent pollution of soil moisture
- To understand soil moisture conservation in organic systems
- To understand prevention of soil moisture pollution in organic systems
- What manures are
- Benefits of manure application
- Possible disadvantages of manure application

- To understand fallow systems
- To know the features of fallow systems
- To know the benefits and disadvantages of fallow systems
- To understand the act of mulching
- To know the benefits/ importance of mulching
- To know act of mulching
- To know the benefits of mulching
- To understand mixed farming systems
- To know the benefits of mixed farming systems
- To know the disadvantages of the system
- To understand the practice of intercropping, crop rotation and mono-cropping in organic systems of crop production.
- To understand biodiversity
- To know the levels of biodiversity
- To understand biodiversity conservation
- To know the measures of biodiversity conservation
- To know the importance of biodiversity conservation
- To know the threats to biodiversity
- To understand sustainable land clearance
- To know the factors that determine land clearing
- To know the factors that determine the choice of a land clearing technique
- To know the types of land clearing techniques
- To know the advantages and disadvantages of land clearing
- To understand organic crop protection
- To know the common crop pest in organic crop production systems
- To know the organic pest management strategies
- To know the measures of pest control in organic crop production systems.
- To know the benefits of organic pest control measures
- To know organic foods
- To know the standards for organic foods
- To understand certification of organic foods
- To know the procedures for certification of organic foods
- To know the benefits of certification of organic products
- To understand the marketing of organic foods
- To know the advantages of organic agriculture
- To know the disadvantages of organic agriculture
- To understand site selection in organic cropping systems
- To know the factors to be considered in selecting sites for organic crop production
- To determine pest, disease and weed management methods
- To understand harvesting and storage of produce in organic systems

- To determine methods of pest (insect, nematode, weed, vertebrate and pathogen) control in organic crop production systems.
- To understand the use of botanicals as pest control measures in organic crop production systems.
- To understand bio-intensive integrated pest management in organic crop production systems.

WORKING THROUGH THIS COURSE

Studying the units as well as other recommended materials is necessary for you to successfully complete the course. You will be required to answer some questions based on what you have read in the course to reaffirm the major points. There are tutor marked assignments at the end of each unit which you are expected to submit as it forms part of your continuous assessment. The course should take you 12 to 13 weeks to complete after which there will be a final examination. The component of the course is given to you to enable you allocate your time appropriately to each unit in order to successfully complete the course in good time.

COURSE MATERIALS

The main components of the course are:

1. Course Guide
2. Study Units
3. Tutor Marked Assignments
4. References/Further reading

STUDY UNITS

Module 1: Soil Resource Management In Organic Crop System (Soil And Water Conservation).

Unit 1: Definition, Importance of Soil Conservation in Organic Crop System and Practices that Adversely Affect the Soil in Organic Crop System.

Unit 2: Soil Conservation Practices in Organic Cropping Systems

Unit 3: Soil Water Conservation in Organic Crop System

Module 2 Soil Fertility Evaluation And Management (Manuring, Fallowing, Mulching, Composting).

Unit 1: Manuring: Definition, Benefits of Manure Application and Possible Disadvantages of Manure Application

Unit 2: Fallowing: Definition, Features, Advantages and Disadvantages

Unit 3: Mulching

Unit 4: Composting

Module 3: Mixed Farming and Cropping Systems in Organic Crop Production (Intercropping, Crop Rotation, Mono-Cropping e.t.c).

Unit 1: Mixed Farming in Organic Systems (Definition, Benefits of Mixed Farming and Disadvantages)

Unit 2: Cropping Systems in Organic Crop Production (Intercropping, Crop Rotation, Mono-Cropping Etc).

Module 4: Conservation of Biodiversity.

Unit 1: Definition of Biodiversity and Levels of Biodiversity

Unit 2: Biodiversity Conservation: Definition and Measures of Biodiversity Conservation

Unit 3: Importance of Biodiversity Conservation and Threats to Biodiversity

Module 5: Sustainable Land- Clearing System.

Unit 1: Definition, Factors Affecting Land Clearing

Unit 2: Factors Determining the Choice of a Land Clearing Technique, Land Clearing Techniques, Advantages and Disadvantages of Land Clearing

Module 6: Crop Protection in Organic Agriculture.

Unit 1: Definition; Organic Crop Protection, Crop Pest in Organic Crop Production, Organic Pest Management Strategies

Unit 2: Crop Protection Measures in Organic Agriculture, Benefits of Organic Pest Control Measures.

Module 7: Organic Foods, Organic Standards, Certification and Market, Benefits of Certification of Organic Products

Unit 1: Organic Foods and Organic Standards

Unit 2: Certification And Market of Organic Foods, Benefits of Certification of Organic Products

Module 8: Advantages and Disadvantages of Organic Agriculture.

Unit 1: Advantages and Disadvantages of Organic Agriculture.

Module 9: Basic Practices in Organic Crop Production: Pre-Planting Operations (Site Selection, Land Preparation), Planting Operations (Seed Selection, Planting) and Post-Planting Operations (Pest, Disease and Weed Management, Harvest and Storage).

Unit 1: Pre-Planting Operations (Site Selection, Land Preparation)

Unit 2: Planting Operations (Seed Selection, Planting) and Post-Planting Operations (Pest,

Disease and Weed Management, Harvest and Storage).

Module 10: Pest (Insects, Nematodes, Weeds, Vertebrates and Pathogens) Management Methods in Organic Crop Production. Use of Botanicals and Bio-Intensive Integrated Pest Management

Unit 1: Pest (Insects, Nematodes, Weeds, Vertebrates and Pathogens) Management Methods in Organic Crop Production.

Unit 2 Use of Botanicals and Bio-Intensive Integrated Pest Management

TUTOR MARKED ASSIGNMENTS

There are tutor marked assignments and self assessments in each unit which you are required to do as it will help you revise what you have learnt in the unit. You are required to do the tutor marked assignments and submit as your assignment for the course. This would give you a better understanding of the course. Your tutorial facilitator will notify you of the particular tutor marked assignment you are to do and submit. Ensure you submit your assignment to your tutor before the given deadline in the presentation schedule and assignment file. If you cannot meet the given deadline, endeavor to contact your tutor before the due date for a possible extension. Extensions will be given only to exceptional cases. The contents of this material in addition to references provided for further reading are sufficient to enable you complete your assignments however, you can search out other references for a better understanding of the course.

FINAL EXAMINATION AND GRADING

The final examination for the course will be 2hrs duration and consist of six theoretical questions and you are expected to answer four questions. The total Marked for the final examination is 70 Marked. The examination will consist of questions, which reflect the tutor Marked assignments that you might have previously encountered and other questions within the course covered areas. All areas of the course will be covered by the assignment. You are to use the time between finishing the last unit and sitting for the examination to revise the entire course. You might find it useful to review your Tutor Marked Assignments before the examination. The final examination covers information from all parts of the course.

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**Pest (Insects, Nematodes, Weeds, Vertebrates and Pathogens)
Management Methods in Organic Crop Production. Use of
Botanicals and Bio-Intensive Integrated Pest Management**

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MODULE 1: SOIL RESOURCE MANAGEMENT IN ORGANIC CROP SYSTEM (SOIL AND WATER CONSERVATION).

Unit 1: Definition, Importance of Soil Conservation in Organic Crop System and Practices that Adversely Affect the Soil in Organic Crop System.

Unit 2: Soil Conservation Practices in Organic Cropping Systems

Unit 3: Soil Water Conservation in Organic Crop Systems

UNIT 1: DEFINITION, IMPORTANCE OF SOIL CONSERVATION IN ORGANIC CROP SYSTEM AND PRACTICES THAT ADVERSELY AFFECT THE SOIL IN ORGANIC CROP SYSTEM.

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- 1.0 Introduction
- 2.0 Objectives
- 3.0 Main content
 - 3.1 Definition of soil conservation
 - 3.2 Importance of Soil conservation in organic crop system
 - 3.3 practices that adversely affect the soil in organic crop system
- 4.0 Conclusion
- 5.0 Summary
- 6.0 Tutor marked assignments
- 7.0 References/ further reading

1.0 INTRODUCTION

Soil is the major medium for plant growth. It is a mixture of organic materials, minerals, gases, liquids and organisms that together support life. These are all critical to crop production and thus the soil quality must be conserved. However, erosion caused by water and wind, total crop removal, continuous cropping, indiscriminate use of inorganic fertilizers as well as other synthetic chemicals are practices that reduce soil organic matter content and thereby compromise the soil quality. The importance of conserving the soil and what can be done to conserve the soil will be seen in this unit and subsequent ones.

2.0 OBJECTIVES

At the end of this unit, the student should be able to

- Definition Soil conservation in organic crop system
- know some practices/ what can destroy soil
- Know the importance of Soil conservation in organic crop system

3.0 MAIN CONTENT

3.1 Definition

Soil conservation is the preservation of soil quality by adopting practices that stop the decline in soil quality and overtime improve soil quality. Soil quality deterioration is basically due to erosion (water and wind), practices that reduce soil organic matter content e.g. total crop removal, continuous cropping, indiscriminate use of inorganic fertilizers as well as other synthetic chemicals etc. Soil conservation practices in organic cropping systems include: maintaining soil cover, crop residues, limiting soil disturbance, incorporation of manures etc help to maintain soil quality.

3.2 Importance of Soil Conservation in Organic Crop System

- Biodiversity conservation
- Maintenance of soil quality (structure, texture, water holding capacity, nutrient status)
- Prevents soil erosion

3.3 Practices that Adversely Affect the Soil in Organic Crop System

- total crop removal
- continuous cropping
- indiscriminate use of inorganic fertilizers as well as other synthetic chemicals

SELF-ASSESSMENT

1. Define soil conservation in organic crop systems
2. What practices adversely affect soil quality
3. State the importance of soil conservation

4.0 CONCLUSION

Soil conservation preserves soil quality which consequently guarantees food security

5.0 SUMMARY

Soil is the major medium for plant growth. It is a mixture of organic materials, minerals, gases, liquids and organisms that together support life. Total crop removal, continuous cropping, indiscriminate use of inorganic fertilizers as well as other synthetic chemicals adversely affect soil quality. Biodiversity, soil characteristics and soil erosion is prevented when soil conservation is done.

6.0 TUTOR MARKED ASSIGNMENTS

- a. Define soil conservation in organic crop systems
- b. List 3 practices that adversely affect soil quality
- c. State 3 reasons why soil should be conserved

7.0 REFERENCES/ FURTHER READING

Organic Crop Production Soil Conservation Practices/Organic Crops.

www.Saskatchewan.ca/business/agriculture-natural-resources-and-industry/agribusiness-farmers-and-ranchers/crops-and-irrigation/organic-crop-production-soil-conservation-practices

UC Sustainable Agriculture Research and Education Program 2017. "Soil Nutrient Management". What is Sustainable Agriculture? UC Division of Agriculture and Natural Resources. <http://asi.ucdavis.edu/programs/ucsarep/what-is-sustainable-agriculture/practices/soil-nutrient-management>.

UNIT 2: SOIL CONSERVATION PRACTICES IN ORGANIC CROPPING SYSTEMS

CONTENTS

- 1.0 Introduction
- 2.0 Objectives
- 3.0 Main content
 - Soil conservation practices in organic cropping systems
- 4.0 Conclusion
- 5.0 Summary
- 6.0 Tutor marked assignments
- 7.0 References/ further reading

1.0 INTRODUCTION

There are different practices adopted by farmers as soil conservation measures some of which are; maintaining soil cover, crop residues, limiting soil disturbance and incorporation of manures. These have been proven to improve or maintain the quality of soils over time.

2.0 OBJECTIVE

To know the basic practices used as soil conservation measures

3.0 MAIN CONTENT

- Maintaining soil cover/ cover crops. The inclusion of cover crops increases soil organic matter and nutrient availability without relying on chemical fertilizers. Cover crops protect the soil against erosion wind or by water as the canopy cover reduces soil

erosion by intercepting the rainfall and reducing the kinetic energy of the rain drops and splash detachments.

- Crop residues are the left over's (roots, chaff, stems and leaves) after a crop is harvested and they are the prime source of organic matter replenishment and consequently boosting soil fertility. Crop residues also improve soil properties such as infiltration, aeration, water holding capacity and particle aggregation as well as reduce evaporation because they serve as ground cover.
- Limiting soil disturbance (Reduced tillage). Reducing the depth of tillage, speed and number of operations help conserve crop residue and soil moisture. Reduced tillage slows down decomposition of organic matter thereby allows accumulation of crop residues on soil surface thus reducing erosion caused by water or wind.
- Green manure: incorporation of green or fresh vegetative material into the soil. Green manure crops especially leguminous crops add nitrogen and organic matter to the soil thus improving fertility and tilth. E.g. sweet clover incorporated as green manure at the 10% bloom contributes its maximum amount of nitrogen into the soil and also allows soil moisture recharge for the following year's crop.
- Animal manure: spreading of livestock and poultry manure provides not only nutrients required for plant growth but has a major beneficial effect on soil tilth and particle aggregation. The organic materials contained in the manure act as binding agents in stabilizing soil structure thus enhancing water infiltration, water holding capacity and aeration as well as resistance to wind and water erosion.
- The use of rotations that include active plant growth (cover crops, intercrops etc.) as much as possible and that minimizes bare fallow enhances soil conservation. The use of leguminous crops enhances biological nitrogen fixation as the major source of N thus improving soil nutrient status.

SELF ASSESSMENT

- What are the practices used as measures of soil conservation?

4.0 CONCLUSION

Soil conservation is a necessity as soil is the major medium used by farmers for cultivation of their crops and therefore the right measures have to be adopted to ensure that the soil quality is not compromised.

5.0 SUMMARY

Soil conservation measures that can be adopted include maintaining soil cover/ cover crops, leaving crop residues on field, limiting soil disturbance/ reduced tillage, incorporation of manures and crop rotation.

6.0 TUTOR MARKED ASSIGNMENT

- ✓ Discuss the various practices adopted as soil conservation measures

7.0 REFERENCES/FURTHER READING

Organic Crop Production Soil Conservation Practices/Organic Crops.

www.Saskatchewan.ca/business/agriculture-natural-resources-and-industry/agribusiness-farmers-and-ranchers/crops-and-irrigation/organic-crop-production-soil-conservation-practices

UC Sustainable Agriculture Research and Education Program 2017. "Soil Nutrient Management". What is Sustainable Agriculture? UC Division of Agriculture and Natural Resources. <http://asi.ucdavis.edu/programs/ucsarep/what-is-sustainable-agriculture/practices/soil-nutrient-management>.

UNIT 3: SOIL WATER CONSERVATION IN ORGANIC CROP SYSTEM

CONTENTS

- 1.0 Introduction
- 2.0 Objectives
- 3.0 Main content
 - 3.1 Definition of soil water conservation
 - 3.2 Soil water conservation practices in organic cropping systems
- 4.0 Conclusion
- 5.0 Summary
- 6.0 Tutor marked assignments
- 7.0 References/ further reading

1.0 INTRODUCTION

Soil water is a basic growth requirement or resource for crop as it ensures turgidity of cells, nutrient dissolution into forms that can be taken up by plants etc thus the need to ensure it is adequately conserved.

2.0 OBJECTIVES

- ✓ To understand soil moisture conservation in organic systems
- ✓ To understand prevention of soil moisture pollution in organic systems

3.0 MAIN CONTENT

3.1 Definition

Soil water conservation is the management of soil water to ensure availability and absence of pollutants. It ensures that the uptake of water from an ecosystem does not exceed its natural replacement.

3.2 Soil water conservation practices in organic cropping systems

- ✓ Soil can better hold moisture for plants to thrive through adoption of good soil management practices such as fertilizing with manures, adding compost and reducing tillage frequency.
- ✓ Crop rotation: rotating different crop types by season or year enhances soil moisture conservation as different crops need different amounts of water. Additionally, rotating crops with different rooting systems or zones enhances water uptake at different soil layers thus reduces exploitation of only one soil layer.
- ✓ Cover crops: the more the soil is covered with vegetation, the better is the soil protection against water loss through evaporation.
- ✓ Alley cropping: pruning of hedgerows e.g. *Sesbania* sp, *Leucaena* sp to serve as mulch materials cover the soil surface thus reducing soil moisture loss through evaporation.

SELF-ASSESSMENT

- Define soil water conservation
- Explain the soil water conservation practices in organic cropping systems

4.0 CONCLUSION

Soil moisture conservation helps maintain soil water quality and availability as it ensures that the uptake of water from an ecosystem does not exceed its natural replacement.

5.0 SUMMARY

Soil water conservation is the management of soil water to ensure availability and absence of pollutants. These can be achieved through the adoption of good cultural practices such as incorporation of manures, crop rotations, planting cover crops and alley cropping.

6.0 TUTOR MARKED ASSIGNMENTS

Define soil water conservation

Explain 4 Soil water conservation practices in organic cropping systems

7.0 REFERENCES/ FURTHER READING

Anonymous 2018. 8 Tips for Agricultural Water Conservation. www.sigfox.com/en/news/8-tips-agricultural-water-conservation

Nigatu Dabi, Kalkidan Firkirie and Tewodros Mulualem, 2017. Soil and Water Conservation Practices on Crop Productivity and its Economic Implications in Ethiopia: A Review. Asian Journal of Agricultural Research, 11:128-136

MODULE 2 SOIL FERTILITY EVALUATION AND MANAGEMENT (MANURING, FALLOWING, MULCHING, COMPOSTING).

Unit 1: Manuring: Definition, Benefits of application and possible disadvantages of manure application

Unit 2: Fallowing

Unit 3: Mulching

Unit 4: Composting

UNIT 1: MANURING: DEFINITION, BENEFITS OF MANURE APPLICATION AND POSSIBLE DISADVANTAGES OF MANURE APPLICATION

CONTENTS

- 1.0 Introduction
- 2.0 Objectives
- 3.0 Main content
 - 3.1 Definition
 - 3.2 Benefits of manure application
 - 3.3 Possible disadvantages of manure application
- 4.0 Conclusion
- 5.0 Summary
- 6.0 Tutor marked assignments
- 7.0 References/ further reading

1.0 INTRODUCTION

Manuring refers to manure application or incorporation into the soil. Addition of which boost soil fertility as well as improve soil physical and chemical properties. Manures could be from plant sources (green manure), from animals (e.g. cow dung, poultry manure) or a combination of plant and animal sources (compost).

2.0 OBJECTIVES: at the end of this unit the student should know

- i. What manures are
- ii. Benefits of manure application
- iii. Possible disadvantages of manure application

3.0 MAIN CONTENT

3.1 Definition of Manuring

Manures refer to any natural substance for fertilizing the soil especially dung or refuse e.g. farm yard manure, green manure, compost etc. The process of adding the manures to the soil is referred to as manuring.

3.2 Benefits of Manure Application

- i. Increased soil fertility: addition of manures help build up soil nutrient status e.g. N,P,K as well as micro nutrients like Mn. Nutrient content of manures however varies depending on source, moisture content, storage and handling methods.
- ii. Liming effect: manures from dairy and poultry have liming effects and actually counteract soil acidification.
- iii. Soil aggregation: incorporation of manures increase soil aggregation and pore spaces
- iv. Soil organic matter content: application of manures increases soil organic matter content which results in improved soil structure and water infiltration rate.
- v. Drainage: application of manures improves drainage of soils especially clay soils
- vi. Water holding capacity: manures when applied to soils enhance the water retention capacity of soils.

3.3 Possible Disadvantages of Manure Application

1. Weed infestation: some manures carry weed seeds e.g. cow dung which can constitute a problem on crop fields.
2. Zinc deficiency: can be induced or increased with repeated high rates of manure especially on sandy soils
3. Salinity problems: application of manures could cause salinity problems on poorly drained soils, soils with existing salinity problems or unusually high application rates.
4. Bulky in nature thus transportation to fields can be difficult

SELF-ASSESSMENT

- a) Define manuring
- b) What are the benefits of manure application?
- c) What are the possible disadvantages of manure application?

4.0 CONCLUSION

Manure application helps boost soil nutrient status and has little or no negative impact on the environment i.e. it is ecosystem friendly.

5.0 SUMMARY

Manures refer to any natural substance for fertilizing the soil especially dung or refuse. Application of manures have lots of benefits some of which include; Increase in soil organic matter and nutrient content, soil aggregation, water holding capacity, drainage and has liming effect

6.0 TUTOR MARKED ASSIGNMENTS

1. What is manuring?
2. What are the benefits of manure application?
3. What are the possible disadvantages of manure application?

7.0 REFERENCES/ FURTHER READING

Sustainable Agriculture Research and Education (SARE) 2019. Effects of Manuring on Soils

UNIT 2: FALLOWING: DEFINITION, FEATURES, ADVANTAGES AND DISADVANTAGES

CONTENTS

- 1.0 Introduction
- 2.0 Objectives
- 3.0 Main content
 - 3.1 Definition
 - 3.2 Features of fallow systems
 - 3.3 Advantages of fallow systems
 - 3.4 Disadvantages of fallow systems
- 4.0 Conclusion
- 5.0 Summary
- 6.0 Tutor marked assignments
- 7.0 References/ further reading

1.0 INTRODUCTION

Crop cultivation results in a decline in the fertility of the soil over time. This often calls for the farmer to allow his field or farm to rest. The period of time the field is allowed to rest or remains uncultivated is referred to as fallow period. Land fallowing enables a field to regain its some or all the lost nutrients.

2.0 OBJECTIVES

- ✓ To understand fallow systems
- ✓ To know the features of fallow systems
- ✓ To know the benefits and disadvantages of fallow systems

3.0 MAIN CONTENT

3.1 Definition

System of farming where by land is cultivated for a period of time and then left uncultivated (fallowed) for some years so that its fertility can be restored. The fallow land is left dormant between planting seasons for about 3-4 years in order to allow the soil regain its lost nutrients. A fallowed land will have good vegetation and the leaves will fall and decompose to improve soil nutrients. Nutrients on the fallow land are recycled.

3.2 Features of Fallow Systems

- It is mainly practiced by peasant farmers
- It is common in rural areas with abundant farm lands
- Productivity per unit of land or per unit of labour is low
- Farmlands are allowed fallow after one or two years of cultivation
- It is practiced where population is low

3.3 Advantages of Fallow Systems

- It aids the natural restoration of soil nutrients during the fallow period
- It can be used to check erosion and leaching
- It helps to control plant pest and diseases
- Easy to practice as little or no technology is required

3.4 Disadvantages of Fallow Systems

- It leads to land fragmentation due to population increase
- There is no provision for expansion in bush fallowing as it does not lead to mechanization
- Fallow years are too short to fully restore soil fertility

SELF-ASSESSMENT

- Define fallowing
- List the features of fallow systems.
- What are the advantages of fallow systems?
- State the disadvantages of fallow systems

4.0 CONCLUSION

Fallowing is a necessary practice given the major benefit of restoring lost soil nutrients. The practice is easy as no specialized skill is required however adoption of the practice is hampered by the reduced land areas due to population increase among other factors.

5.0 SUMMARY

Fallowing is a system of farming where by land is cultivated for a period of time and then left uncultivated for some years so that its fertility can be restored. In addition to restoration of soil fertility, it also helps in controlling erosion, leaching, pest and diseases spread. The practice however is limited greatly due to increase in population.

6.0 TUTOR MARKED ASSIGNMENTS

- What is fallowing?
- List 5 features of fallow systems.
- What are the advantages of fallow systems?
- State the disadvantages of fallow systems

7.0 REFERENCES/ FURTHER READING

Bush fallowing- Meaning, Advantages and Disadvantages.
www.schoolmattazz.com/2016/10/bush-fallowing

UNIT 3: MULCHING

CONTENTS

- 1.0 Introduction
- 2.0 Objectives
- 3.0 Main content
 - 3.1 Definition
 - 3.2 Benefits of Mulching
- 4.0 Conclusion
- 5.0 Summary
- 6.0 Tutor marked assignments
- 7.0 References/ further reading

1.0 INTRODUCTION

Covering the soil surface (mulching) offers a protection against erosion (wind and water) and ensures moisture conservation. It tends to create a micro climate around root zone thus ensuring healthy plant growth.

2.0 OBJECTIVES

- To understand the act of mulching
- To know the benefits/ importance of mulching

3.0 MAIN CONTENT

3.1 Definition

Mulching is the process of covering the soil surface to make more favorable conditions for plant growth and development. The mulch (layer of material) could be organic materials e.g. manures, straw, grass clippings or inorganic materials like plastics or rubber.

3.2 Benefits of Mulching

- Reduces loss of moisture from the soil surface(evaporation)
- Suppresses weed growth thus a measure of weed control
- Creates a micro climate around root zone thus ensuring healthy plant growth
- Reduces soil erosion
- Nutrient source to plants from decomposed mulch materials
- Encourages microbial activity and worms in favor of soil

SELF-ASSESSMENT

- What is mulching?
- List the benefits of mulching
- List the materials that can be used as mulches

3.0 CONCLUSION

Mulching the soil is an important farmer's practice which basically enhances soil health by protecting the soil surface.

5.0 SUMMARY

Mulching is the process of covering the soil surface with organic materials such as manures, straw, grass clippings or inorganic materials like plastics or rubber to make more favorable conditions for plant growth and development. The practice has numerous benefits some of which include reduction of erosion and evaporation, weed suppression, addition of soil organic matter etc.

6.0 TUTOR MARKED ASSIGNMENTS

- What is mulching?

- List 6 benefits of mulching
- List 6 materials that can be used as mulches

7.0 REFERENCES/ FURTHER READING

ecochem: Innovative solutions for sustainable Agriculture. Ecochem.com/t_compost_faq.html

UNIT 4: COMPOSTING

CONTENTS

- 1.0 Introduction
- 2.0 Objectives
- 3.0 Main content
 - 3.1 Definition
 - 3.2 Benefits of composting
- 4.0 Conclusion
- 5.0 Summary
- 6.0 Tutor marked assignments
- 7.0 References/ further reading

UNIT 4: COMPOSTING

CONTENTS

1.0 INTRODUCTION

Recycling of various organic materials such as food or plant materials otherwise regarded as waste products produces a soil conditioner called humus. The process of breaking down the waste materials is referred to as composting and it is carried out by bacteria, fungi, worms and other organisms under aerobic conditions.

2.0 OBJECTIVES

- To know act of mulching
- To know the benefits of mulching

3.0 MAIN CONTENT

3.1 Definition

Composting is a natural biological process carried out by various micro organisms e.g. bacteria and fungi that utilize solid waste as an energy source and break down organic material into simpler

substances. It can also be defined as the decomposition of organic waste such as food or plant materials by bacteria, fungi, worms and other organisms under aerobic conditions. The process recycles various organic materials otherwise regarded as waste products and produces a soil conditioner called humus.

3.2 Benefits of Composting

- Compost increases the soil nutrient level
- Product (compost) serve as soil amendment improving the soils structure and aeration
- It increases infiltration thus reducing surface runoff
- Waste management: means of reducing the amount of waste e.g. yard waste, food scrapes, leaves, crop residues, sewage sludge etc. that would otherwise be disposed in landfills.
- The compost can be used as mulching material
- Potting mix: blended with potting soil for container plants

SELF-ASSESSMENT

- ✓ Define composting
- ✓ What are the benefits of composting?

4.0 CONCLUSION

Composting (biological process of decomposition of organic waste by various micro organisms) is a beneficial practice which serves as soil amendment improving the soils structure, texture, soil water conservation and aeration.

5.0 SUMMARY

Composting is a natural biological process carried out by various micro organisms e.g. bacteria and fungi that utilize solid waste as an energy source and break down organic material into simpler substances. Composting has numerous benefits some of which include: increase in soil nutrient level, water infiltration, means of waste disposal, used as mulch materials and soil for potted plants.

6.0 TUTOR MARKED ASSIGNMENTS

- ✓ Define composting
- ✓ What are the benefits of composting?

7.0 REFERENCES/ FURTHER READING

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MODULE 3: MIXED FARMING AND CROPPING SYSTEMS IN ORGANIC CROP PRODUCTION (INTERCROPPING, CROP ROTATION, MONO-CROPPING ETC).

Unit 1: Mixed farming in organic systems (Definition, Benefits of mixed farming and Disadvantages)

Unit 2: Cropping systems in organic crop production (intercropping, crop rotation, mono-cropping etc).

UNIT 1: MIXED FARMING IN ORGANIC SYSTEMS (DEFINITION, BENEFITS OF MIXED FARMING AND DISADVANTAGES)

CONTENTS

- 1.0 Introduction
- 2.0 Objectives
- 3.0 Main content
 - 3.1 Definition
 - 3.2 Benefits of mixed farming
 - 3.3 Disadvantages of mixed farming systems
- 4.0 Conclusion
- 5.0 Summary
- 6.0 Tutor marked assignments
- 7.0 References/ further reading

1.0 INTRODUCTION

Mixed farming involves cultivation of crops alongside rearing of animals for meat, milk, hides or skin. There is a synergy between the crops and animals, where the dung or droppings from animals is used to fertilize crops while the produce or residues from crops are fed to the animals. The system enhances recycling of resources thus making crop and livestock production largely in balance with nature as such promoting organic agricultural production.

2.0 OBJECTIVES

- i. To understand mixed farming systems
- ii. To know the benefits of mixed farming systems
- iii. To know the disadvantages of the system

3.0 MAIN CONTENT

3.1 Definition

Mixed farming is a system of farming which involves both the growing of crops and the raising of livestock. It involves cultivation of crops alongside rearing of animals for meat, milk, hides or skin. It is an environmental friendly agricultural production system because it is at least a partially closed system. The waste product (crop residues) of one enterprise (crop production) which would otherwise be loaded on to the natural resource base are used by the other enterprise (livestock production) which returns its own waste products (manure) back to the first enterprise. It means that dung or droppings from animals is used to fertilize crops while the produce or residues from

crops is fed to the animals. The system enhances recycling of resources thus making crop and livestock production largely in balance with nature as such promoting organic agricultural production.

3.2 Benefits of Mixed Farming

- The system helps maintain ecosystem function and health by promoting greater biodiversity
- It maintains soil fertility by recycling soil nutrients thus reducing the need for artificial fertilizers.
- Enhances water conservation and reduces erosion
- Makes the best use of crop residues as when they are not used as feed, stalks may be incorporated into the soil as manure.
- It enhances intensive farming with less dependence on natural resources and preserving more than would be the case if food demands were to be met by crop and livestock production undertaken in isolation.
- Farmers can keep their fields under continuous thus enhancing greater food security and improved household nutrition levels.

3.3 Disadvantages of Mixed Farming Systems

- Production levels can be lower than in specialized systems(monoculture)
- Overgrazing has resulted in some systems been degraded
- Initial cost of establishment could be high.
- Controlling, monitoring and maintenance of the farm may be difficult because of the multiple activities running simultaneously.

SELF-ASSESSMENT

- What is mixed farming?
- List the benefits of mixed farming systems
- What are some disadvantages of mixed farming systems

4.0 CONCLUSION

Mixed farming (crop and animal production) systems are an environmentally friendly agricultural production system because it is a partially closed system where the waste product of one enterprise would be used as a resource by the other enterprise. The crop residues are used as feed for the animals while their dung is used as manure for the crops.

5.0 SUMMARY

Mixed farming involves cultivation of crops alongside rearing of animals for products such as meat, milk, hides or skin. The system helps maintain ecosystem function and health, soil nutrients and moisture etc. The practice however has some drawbacks such as high cost of initial establishment, lower production than in specialized systems (monoculture) also controlling, monitoring and maintenance of the farm may be difficult because of the multiple activities running simultaneously.

6.0 TUTOR MARKED ASSIGNMENTS

1. Define mixed farming.
2. List five benefits of mixed farming systems
3. What are some disadvantages of mixed farming systems

7.0 REFERENCES/ FURTHER READING

Mixed farming and the environment fao.org/3/x5303e/x5303e09.htm

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UNIT 2: CROPPING SYSTEMS IN ORGANIC CROP PRODUCTION (INTERCROPPING, CROP ROTATION, MONO-CROPPING ETC).

CONTENTS

- 1.0 Introduction
- 2.0 Objectives
- 3.0 Main content
 - 3.1 intercropping in organic systems
 - 3.2 crop rotation in organic systems
 - 3.3 mono-cropping in organic systems
- 4.0 Conclusion
- 5.0 Summary
- 6.0 Tutor marked assignments
- 7.0 References/ further reading

CONTENTS

1.0 INTRODUCTION

Intercropping is the growing of two or more crops concurrently on the field. The practice enhances maximum utilization of above and below growing resources. Additionally, it

gives security against total crop failure in incidences of pest or disease attack. In organic systems which do not involve the usage of pesticides, the practice helps break pest and disease cycles as well as serve as a weed control measure. Crop rotation is the growing of crops in sequence or an alternating manner while mono-cropping

2.0 OBJECTIVES

- ✓ To understand the practice of intercropping, crop rotation and mono-cropping in organic systems of crop production.

3.0 MAIN CONTENT

3.1 Intercropping in Organic Systems

Intercropping is growing more than one crop simultaneously in the same field during a growing season. In organic systems, the practice gives significant pest suppression effects enabling cultivation without using pesticides. Intercropping in organic systems provides effective suppression of weeds and diseases and thereby improves grain yield and quality. The practice of intercropping brings diversity into the agro-ecosystem. This diversity is considered a key to their resilience and stability. In organic systems of intercropping, legumes are mostly included in the intercrop because of their nitrogen fixing ability thus boosting the fertility of the soil since chemical fertilizers are not used. Manures (green, compost, farmyard etc) are also used to improve or boost the nutrient status of the soil.

3.2 Crop Rotation in Organic Systems

Crop rotation is a valuable management tool for organic farmers which involve the cultivation of different crops in temporal succession on the same land basically to preserve the productive capacity of the soil. The succeeding crop will be different specie than the previous crops. In organic systems, given the absence of chemical usage, the use of crop rotation help break host cycles for pest and diseases. Alternation of crops with different seasonal patterns and growth habits can also help to suppress weeds. Properly managed rotations can also increase micro biological diversity and activity; raise organic matter content, conserve soil and enhance soil structure. Rotations in organic systems usually include a rest (fallow) period for individual fields where grass or a green manure crop e.g. Clover is planted for a season or more before being grazed or ploughed into the soil to add fertility.

3.3 Mono-Cropping in Organic Systems

Mono-cropping is the practice of planting one crop in the same place year in year out. Planting the same crop in the same place each year zaps nutrients from the earth and leaves soil weak and unable to support healthy plant growth. The practice also creates spread of pest and

diseases and in organic systems, chemicals usage is not allowed to remedy the pest or diseases. The measures adopted under organic mono-culture systems include:

- Introduce diversity: this can be achieved by introducing a mixture of genotypes of the same crop species with different nutrient levels. E.g. the parts consumers eat such as corn ears or broccoli heads could be identical but the parts the insects eat e.g. leaves could vary. This also can be done to reduce disease spread among crops.
- Gene silencing: this is achieved by the use of bio-stimulants derived from naturally occurring soil bacteria e.g. nematodes. The gene silencing process is triggered when the bio-stimulants, which are metabolites of bacteria occurring naturally in the soil to a crop e.g. wheat. The bio-stimulants can be applied either by soaking the seeds or roots of the plant in a solution containing the bio-stimulants or by applying the solution to the soil in which the plants are growing.
- Natural control measures such as crop rotation biological control measures can be adopted.
- The fertility of soils under monoculture in organic systems can be boosted and maintained through the application of manures e.g. compost, farm yard manure, green manure etc.
- Manipulating cultural practices such as early planting to avoid certain diseases or pest. e.g. planting susceptible crops at times of the year when certain pest or diseases are less pervasive

SELF-ASSESSMENT

- Define intercropping
- How does the practice benefit farmers practicing organic agriculture?
- Define crop rotation.
- What is the importance of crop rotation in organic systems?
- Define mono-cropping, state its limitations and possible solutions to the limitations.

4.0 CONCLUSION

Organic farming seeks to ensure production of healthy food, soils, plants and keeping the environment a priority. The cropping systems of the farmers some of which include; intercropping, crop rotation and mono-cropping are ensured to be carried out according to the principles guiding organic agriculture one of which is to grow chemical free crops.

5.0 SUMMARY

Intercropping is growing more than one crop simultaneously in the same field during a growing season. In organic systems, the practice gives significant pest, weed, and disease suppression effects enabling cultivation without using chemicals. Crop rotation is another cultivation practice carried out by organic farmers as it is valuable management tool for organic farming which involve the cultivation of different crops in temporal succession on the same land basically to preserve the productive capacity of the soil, break pest and disease cycles. Mono-cropping is the practice of planting one crop in the same place year in year out. The practice tends to mine the soil and creates spread of pest and diseases. However organic control measures such as introducing diversity, gene silencing by using bio-stimulants, crop rotation and manipulating cultural practices can help address the problem of pest and diseases in mono-cropping systems. Soil fertility can be improved in this system through manure application.

6.0 TUTOR MARKED ASSIGNMENTS

- i. What is intercropping?
- ii. How does the practice benefit organic farmers?
- iii. Define crop rotation.
- iv. What is the importance of crop rotation in organic systems?
- v. Define mono-cropping, state its limitations and possible solutions to the limitations.

7.0 REFERENCES/ FURTHER READING

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MODULE 4: CONSERVATION OF BIODIVERSITY.

Unit 1: Definition of biodiversity and Levels of biodiversity

Unit 2: Biodiversity conservation: Definition and Measures of biodiversity conservation

Unit 3: importance of biodiversity conservation and Threats to biodiversity

UNIT 1: DEFINITION OF BIODIVERSITY AND LEVELS OF BIODIVERSITY

CONTENTS

1.0 INTRODUCTION

The variability of life forms on earth constitutes the biodiversity. All forms of life on earth including plants sp, animals, micro organisms, the genes they contain and the ecosystem they form make up biodiversity. These are categorized into three namely: genetic (variation that exist within species), species (the total number of species in a defined area) and ecosystem (variety of habitats, biotic communities and ecological processes) biodiversity.

2.0 OBJECTIVES

- To understand biodiversity
- To know the levels of biodiversity

3.0 MAIN CONTENT

3.1 Definition of biodiversity

3.2 Levels of biodiversity

3.1 Definition of Biodiversity

Biodiversity: refers to the variety and variability of life on earth. It consist of the varieties all forms of life on earth including the different plants, animals, micro organisms, the genes they contain and the ecosystem they form.

3.2 Levels of Biodiversity: these consist of genetic, species and ecosystem biodiversities.

- ❖ Genetic diversity: it is the gene variation that exist within species and populations of plants, animals and micro organisms
- ❖ Species diversity: this refers to the total number of species in a defined area. Mangalet and menhink are some of the indices used in the measurement of species diversity.
- ❖ Ecosystem diversity: this refers to the variety of habitats, biotic communities and ecological processes taking place in the biosphere.

SELF-ASSESSMENT

- What is biodiversity?
- List the stages of biodiversity.

4.0 CONCLUSION

Biodiversity can be said to be all life forms on earth whether plants sp, animals, micro organisms and all that make up the ecosystem.

5.0 SUMMARY

All forms of life on earth including plants sp, animals, micro organisms, the genes they contain and the ecosystem they form make up biodiversity. They exist in three levels namely; genetic, species and the ecosystem.

6.0 TUTOR MARKED ASSIGNMENTS

- I. Define biodiversity
- II. List the 3 stages of biodiversity.

7.0 REFERENCES/ FURTHER READING

Thecla M. Mutia. 2009. Biodiversity conservation. Geothermal Development Company Limited. Nairobi, Kenya. Pp1-10

UNIT 2: BIODIVERSITY CONSERVATION: DEFINITION AND MEASURES OF BIODIVERSITY CONSERVATION

CONTENTS

- 1.0 Introduction
- 2.0 Objectives
- 3.0 Main content
 - 3.1 Biodiversity conservation
 - 3.2 Measures of biodiversity conservation
- 4.0 Conclusion
- 5.0 Summary
- 6.0 Tutor marked assignments
- 7.0 References/ further reading

CONTENTS

1.0 INTRODUCTION

Biodiversity conservation is the preservation, maintenance, sustainable use, recovery and enhancement of the components of biological diversity which include plants, animals, micro organisms etc. this conservation can be achieved by ensuring preservation of natural habitat and by creating artificial habitats e.g. zoo, gene banks etc to preserve endangered species.

2.0 OBJECTIVES

- i. To understand biodiversity conservation
- ii. To know the measures of biodiversity conservation

3.0 MAIN CONTENT

3.1 Biodiversity Conservation

This is the preservation, maintenance, sustainable use, recovery and enhancement of the components of biological diversity. It can also be defined as the protection, upliftment and scientific management of biodiversity so as to maintain it at its threshold level and derive sustainable benefits for the present and future generation.

3.2 Measures of Biodiversity Conservation

The conservation can be ex-situ or in-situ.

- ✓ Ex-situ conservation: it is also known as captive conservation. Components of biodiversity are conserved outside their natural habitat e.g. zoo, museum, gene banks, botanic gardens etc. it is majorly used for endangered species to avoid extinction.
- ✓ The in-situ conservation: the ecosystems and natural habitats are conserved, maintained and recovery of viable populations of species in their natural habitats is ensured.

SELF-ASSESSMENT

- Explain biodiversity conservation.
- Explain the measures of biodiversity conservation

4.0 CONCLUSION

Biodiversity conservation is crucial for maintaining the resilience of ecosystems. Specific actions such as the captive conservation and conservation of ecosystems and natural habitats are necessary.

5.0 SUMMARY

The preservation, maintenance, sustainable use, recovery and enhancement of the components of biological diversity is referred to as biodiversity conservation. This can be achieved through in-situ conservation (i.e. conservation of the ecosystems and natural habitats, maintenance and recovery of viable populations of species in their natural habitats) and ex-situ conservation i.e. captive conservation to protect endangered species.

6.0 TUTOR MARKED ASSIGNMENTS

- i. Define biodiversity conservation.
- ii. Explain the measures of biodiversity conservation

7.0 REFERENCES/ FURTHER READING

Biodiversity and Climate Change Adaptation in Tropical Islands, 2018

Thecla M. Mutia. 2009. Biodiversity conservation. Geothermal Development Company Limited. Nairobi, Kenya. Pp1-10

UNIT 3: IMPORTANCE OF BIODIVERSITY CONSERVATION AND THREATS TO BIODIVERSITY

CONTENTS

- 1.0 Introduction
- 2.0 Objectives
- 3.0 Main content
 - 3.1 Importance of biodiversity conservation
 - 3.2 Threats to biodiversity
- 4.0 Conclusion
- 5.0 Summary
- 6.0 Tutor marked assignments
- 7.0 References/ further reading

CONTENTS

1.0 INTRODUCTION

The variety and variability of life on earth (biodiversity) is threatened due to alteration or destruction of natural habitats, over harvesting of species, environmental pollution, climate change etc. however, biodiversity must be preserved as they maintain the integrity of the environment, provides basic need e.g. food, medicine, industrial raw materials, has aesthetic value etc.

2.0 OBJECTIVES

- To know the importance of biodiversity conservation
- To know the threats to biodiversity

3.0 MAIN CONTENT

3.1 Importance of Biodiversity Conservation

- It maintains the integrity of the environment, expressed as maintaining CO₂ / O₂ balance, regulation of biological cycles, decomposition etc.
- It has utilitarian values as it provides us with basic need e.g. food, medicine, industrial raw materials etc.
- Biodiversity has aesthetic value as it beautifies our environment, enhance leisure or sporting activities etc.
- Ensures survival/existence of life forms regardless of their importance or no importance.

3.2 Threats to Biodiversity

The importance of biodiversity cannot be over emphasized however it is threatened (endangered). These threats are mostly due to human mismanagement of biological resources often misguided by economic policies and faulty institutions. Some of these threats include:

- ❖ Habitat alteration or destruction: increased exploitation of natural resources results in land use changes leading loss in genetic diversity, species reduction and increased changes in the ecosystem such as dwindling populations of organisms.
- ❖ Overharvesting of species: this occurs when a particular species are taken e.g. through hunting, fishing, food gathering, trade etc. at a higher rate than can be sustained by the natural reproductive capacity of the population being harvested. This practice can lead to extinction of certain life forms and eventually leading to loss of species. However certain laws can be made to protect overharvesting, which if eventually happens is called poaching. Harvesting under a given law is called cropping.
- ❖ Pollution from chemicals or thermal emissions is a threat to biodiversity. Industrial activities can result in oil spills, acid precipitation etc. and excessive use of agro chemicals e.g. DDT pollutes the ecosystem thereby constituting a danger to biodiversity.
- ❖ Biological invasion: this occurs when species are introduced intentionally or accidentally in an ecosystem thereby causing changes in the ecosystem. The species are introduced in areas previously not native to them as such are regarded as pollutants. Some impacts of such invasions are hybridization, competition, disease outbreaks, disruption of food webs etc.
- ❖ Climate change: nature has a range of tolerance and survival maintained for ecosystem stability and any change e.g. global warming can result in extinction of some species. The

changes may be gradual or abrupt such that if the limit is exceeded, the upper or lower species could suffer extinction.

- ❖ Increased human population: the increase in human population has also given rise to increased demand for natural resources/ raw materials which consequently has brought about changes in biodiversity.
- ❖ Failed institutional policies: failure of mandated institutions to internalize the values of biodiversity in decision making process of their nation/ populace threatens biodiversity. A holistic approach towards biodiversity conservation by such institutions is therefore necessary.

SELF-ASSESSMENT

- List the importance of biodiversity conservation
- List the threats to biodiversity

4.0 CONCLUSION

Threats to biodiversity exist despite its importance in maintaining the balance of the environment among other functions. The threats are mostly attributed to mismanagement of biological resources often misguided by economic policies and faulty institutions.

5.0 SUMMARY

Biodiversity maintains the integrity of the environment, provides us with basic need e.g. food, medicine, beautifies our environment and ensures survival/existence of life forms. Despite these importances, biodiversity is threatened due to alteration or destruction of habitat, overharvesting of species, biological invasion, climate change, environmental pollution, increase in human population and failed institutional policies.

6.0 TUTOR MARKED ASSIGNMENTS

- i. List 4 importance of biodiversity conservation
- ii. List 5 threats to biodiversity

7.0 REFERENCES/ FURTHER READING

Thecla M. Mutia. 2009. Biodiversity conservation. Geothermal Development Company Limited. Nairobi, Kenya. Pp1-10

MODULE 5: SUSTAINABLE LAND- CLEARING SYSTEM.

Unit 1: Definition and Factors affecting land clearing

Unit 2: Land clearing techniques

Unit 3: Advantages and Disadvantages of bush clearing

UNIT 1: DEFINITION, FACTORS AFFECTING LAND CLEARING

CONTENTS

1.0 Introduction

| | |
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| 2.0 | Objectives |
| 3.0 | Main content |
| | 3.1 Definition of Land Clearing |
| | 3.2 Factors Affecting Land Clearing |
| 4.0 | Conclusion |
| 5.0 | Summary |
| 6.0 | Tutor marked assignments |
| 7.0 | References/ further reading |

CONTENTS

1.0 INTRODUCTION

Sustainable land clearing is the process of clearing land areas without causing any permanent damage to the top soil or terrain. The practice gives benefit of increased organic matter and nutrient recycling from the decomposed materials as well as protection of soil surface. The practice is determined by rainfall of the environment, topography, equipments available for clearing, density of vegetation, soil condition etc.

2.0 OBJECTIVES

- i. To understand sustainable land clearance
- ii. To know the factors that determine land clearing

3.0 MAIN CONTENT

3.1 Definition of Sustainable Land Clearing

Land clearing is the removal of the native vegetation for agricultural purposes and other developmental projects. Sustainable land clearing on the other hand is the process of clearing land areas without causing any permanent damage to the top soil or terrain. It is an eco-friendly practice. In this system cleared vegetation is not burnt but it is used as mulch which later decomposes and adds nutrients to the soil i.e. there is the benefit of increased organic matter and nutrient recycling from the decomposed materials as well as protection of soil surface.

3.2 Factors Affecting Land Clearing

There are factors that affect land clearing and such include:

- The rainfall received in the region to
- The topography of the area to be cleared
- The equipment to be used to clear the land
- Skill of the equipment operators

- The end use of the land being cleared
- Size and kind of trees on the site
- Density of the vegetation
- Soil condition of the site

SELF-ASSESSMENT

- What is sustainable land clearing?
- What are the factors that affect land clearing

4.0 CONCLUSION

Sustainable land clearing is an eco-friendly practice in that cleared vegetation is not burnt but used as mulch materials to protect the soil surface and which later decomposes and adds nutrients to the soil.

5.0 SUMMARY

Sustainable land clearing is a process of land clearing without causing any permanent damage to the top soil or terrain. The cleared vegetation is used as mulch materials which decompose to boost nutrient status of the land. The practice is however influenced by certain factors some of which include; the topography, rainfall, type and density of vegetation, soil type, available clearing equipments etc.

6.0 TUTOR MARKED ASSIGNMENTS

- i. What is sustainable land clearing?
- ii. What are the factors that affect land clearing

7.0 REFERENCES/ FURTHER READING

Sustainable Agriculture and Environment in the humid tropics 1993. Chapter 2: sustainable land use options

Land clearing 101-Advantages and Disadvantages by: fittmaster2016.
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Five most popular land clearing techniques 2019. www.marksclearing.com/5-popular-land-clearing-techniques

UNIT 2: FACTORS DETERMINING THE CHOICE OF A LAND CLEARING TECHNIQUE, LAND CLEARING TECHNIQUES, ADVANTAGES AND DISADVANTAGES OF LAND CLEARING

CONTENTS

- 1.0 Introduction
- 2.0 Objectives
- 3.0 Main content
 - 3.1 Factors Determining the Choice of a Land Clearing Technique
 - 3.2 Land clearing techniques
 - 3.3 Advantages and Disadvantages of Land Clearing
- 4.0 Conclusion
- 5.0 Summary
- 6.0 Tutor marked assignments
- 7.0 References/ further reading

CONTENTS

1.0 INTRODUCTION

Land clearing (removal of trees, stumps, bushes etc.) is majorly done in order to increase size of area put under cultivation. Certain considerations such the area of land to be cleared, cost, type of vegetation to be cleared etc before the adoption of any technique. A suitable technique e.g. cut and grind, push over, pulling etc. is chosen and adopted for effective land clearing.

2.0 OBJECTIVES

- i. To know the factors that determine the choice of a land clearing technique
- ii. To know the types of land clearing techniques
- iii. To know the advantages and disadvantages of land clearing

3.0 MAIN CONTENT

3.1 Factors Determining the Choice of a Land Clearing Technique

Before adopting any technique to clear land, certain considerations or factors need to be made. These include:

- The size of area to be cleared: the area or space to be cleared determines the technique to be adopted, if it is cost effective, timely or if the technique to be adopted is feasible.

- The soil composition as well as the type and amount of vegetation whether trees, bushes, shrubs or grasses determine the type of technique or equipment to be used.
- Land use: what the cleared land will be used for, type of crops to be planted.

3.2 Land Clearing Techniques

- i. Cut and grind: this is suitable for areas with small amount of trees. Bush and weeds are first cleared using tools like brush mower or root plough, after large machines take down trees and pile them up to be taken for processing. Tree stumps can be grinded and used to mulch the soil so they can decompose over time and improve soil fertility.
- ii. Pushover: large trees are pushed over leaving the roots intact. Bulldozers are mostly used for this practice.
- iii. Pulling: anchor chains are attached to the trees and tractors are used to pull it away.
- iv. Pile and burn: land is cleared, piled and burnt. This is an age old tradition.

3.3 Advantages and Disadvantages of Land Clearing

3.3.1 Advantages of bush clearing

- ✓ Cleared vegetation can be used as mulch materials
- ✓ Decomposed vegetation can add nutrient to the soil
- ✓ Income generation from harvested timber
- ✓ Timber harvested can serve as raw material for making paper, furniture and agricultural purposes e.g. building ranches.

3.3.2 Disadvantages of land clearing

- ✓ Rate of tree growth is slower than rate of deforestation
- ✓ Destruction of habitat
- ✓ Erosion
- ✓ Where bulldozers are used, topsoil can be destroyed and value of wood may decrease.
- ✓ Bush burning is risky and pollutes the environment.

SELF-ASSESSMENT

- What factors are to be considered before choosing a land clearing technique?
- List and explain the land clearing techniques.
- State the advantages and disadvantages of land clearing.

4.0 CONCLUSION

Land clearing technique to be used has to be carefully considered to ensure that timely, feasible and cost effective methods of land clearing are adopted.

5.0 SUMMARY

The choice of a land clearing technique e.g. pulling, push over, cut and grind etc. to be adopted is influenced by the land size or area to be cleared, the cost, soil composition, vegetation to be cleared whether trees, shrubs, grasses etc. This ensures effective, sustainable and timely land clearing.

6.0 TUTOR MARKED ASSIGNMENTS

- i. What factors are to be considered before choosing a land clearing technique?
- ii. List and explain 4 land clearing techniques.
- iii. State 4 advantages and disadvantages of land clearing.

7.0 REFERENCES/ FURTHER READING

Five most popular land clearing techniques 2019. www.marksclearing.com/5-popular-land-clearing-techniques

Sustainable Agriculture and Environment in the humid tropics 1993. Chapter 2: sustainable land use options

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Fellcotreeandtractor.com/land-clearing-101-advantages-and-disadvantages

MODULE 6: CROP PROTECTION IN ORGANIC AGRICULTURE.

Unit 1: Definition of organic crop protection, Crop pest in organic crop production, Organic Pest Management Strategies

Unit 2: Crop protection measures in organic agriculture, Benefits of Organic Pest Control Measures

UNIT 1: DEFINITION; ORGANIC CROP PROTECTION, CROP PEST IN ORGANIC CROP PRODUCTION, ORGANIC PEST MANAGEMENT STRATEGIES

CONTENTS

- 1.0 Introduction
- 2.0 Objectives
- 3.0 Main content
 - 3.1 Organic Crop Protection
 - 3.2 Crop Pest in Organic Crop Production
 - 3.3 Organic Pest Management Strategies
- 4.0 Conclusion
- 5.0 Summary
- 6.0 Tutor marked assignments
- 7.0 References/ further reading

CONTENTS

1.0 INTRODUCTION

Organic agriculture ensures healthy food, soil, plants and the environment through the absence of the usage chemicals. Certain pest e.g. insects, weed, pathogens could be detrimental to cultivated crops and therefore the need to employ the appropriate control measure. Pest control measures other than chemicals are usually adopted from natural sources or optimization of the cropping systems e.g. adopting crop rotations to break disease or pest cycles, or usage of resistant or tolerant varieties. Weed control in organic systems is mostly achieved by mechanical means e.g. hoeing, mowing etc.

2.0 OBJECTIVES

- i. To understand organic crop protection
- ii. To know the common crop pest in organic crop production systems
- iii. To know the organic pest management strategies

3.0 MAIN CONTENT

3.1 Organic Crop Protection

Organic crop protection refers to the measures used to prevent, control or remedy disease infection or insect pest or weed infestation in cultivated crops.

3.2 Crop Pest in Organic Crop Production

Crop pest include: insects, weed, pathogens (fungi, bacteria, virus and nematodes), invertebrates and vertebrate animals.

3.3 Organic Pest Management Strategies

There are three management strategies used in pest control, namely: prevention, monitoring and suppression.

Identification and monitoring: identification of pest and their natural enemies is an important step to adequately manage pest. Monitoring is the regular inspection of field crops for pest to determine their abundance and level of damage. The information gathered helps to the decision making regarding management and evaluation of control methods.

SELF-ASSESSMENT

- What is organic pest control?
- List the important pest of crops in organic systems
- Briefly explain the management strategies used in pest control

4.0 CONCLUSION

Crop protection in organic crop production systems can be achieved if fields are monitored or observed regularly and pest are identified early. This will help determine the abundance of the pest and level of damage which will consequently guide in the decision making regarding management methods to be adopted.

5.0 SUMMARY

Organic crop protection refers to the measures used to prevent, control or remedy crop pest namely: insects, weed, pathogens (fungi, bacteria, virus and nematodes), invertebrates and vertebrate animals. Management strategies used in these pest controls are prevention, monitoring and adoption of appropriate measures to suppress the pest.

6.0 TUTOR MARKED ASSIGNMENTS

- i. Define organic pest control
- ii. List four important pest of crops in organic systems
- iii. Briefly explain three management strategies used in pest control

7.0 REFERENCES/ FURTHER READING

UNIT 2: CROP PROTECTION MEASURES IN ORGANIC AGRICULTURE, BENEFITS OF ORGANIC PEST CONTROL MEASURES.

CONTENTS

- 1.0 Introduction
- 2.0 Objectives
- 3.0 Main content
 - 3.1 Insect Pest Control Measures in Organic Crop Production Systems
 - 3.2 Disease Control Measures in Organic Crop Production Systems
 - 3.3 Weed Control Measures in Organic Crop Production Systems
 - 3.4 Benefits of Organic Pest Control Measures
- 4.0 Conclusion
- 5.0 Summary
- 6.0 Tutor Marked Assignments
- 7.0 References/ Further Reading

CONTENTS

1.0 INTRODUCTION

Crop protection measures in organic agriculture are aimed at preventing insect pest, diseases and weed problems through the optimization of the cropping system. Cropping systems such as crop rotations can help break insect pest and disease cycles. Weed control is achieved in organic systems mainly through mechanical control measures. Organic crop protection measures gives control to crop pest while maintaining or having no detrimental effect on biodiversity.

2.0 OBJECTIVES

- To know the measures of pest control in organic crop production systems.
- To know the benefits of organic pest control measures

3.0 MAIN CONTENT

3.1 Insect Pest control measures in organic crop production systems

Pest control measures in organic systems can be achieved through the following means:

- Insect pest can be monitored through visual observation after which the use of pheromone and light traps, sticky traps, water traps, yellow traps, sweep nets, beating trays and pit falls, sticky collars for crawling insects can be adopted as insect pest control measures.
- Cultural pest control: this is achieved by altering the environmental condition of the host or the behavior of the pest to prevent or suppress infestation.
- Mechanical/physical control: this involves hand picking of insects and this is better achieved if the insects are visible and easily accessible.
- Biological control: using beneficial organisms to reduce pest population by introducing natural enemies
- Bio-pesticides: pest are suppressed or repelled rather than eliminated.
- Integrated pest management: incorporates a variety of pest, management tactics such as cultural, mechanical/physical, biological and biophysical methods.

3.2 Disease Control Measures in Organic Crop Production Systems

Disease control can be achieved through:

- Cultivation of tolerant or resistant varieties
- Crop rotation: to break disease cycles
- Cultural practices: manipulating time of planting by sowing early

3.3 Weed Control Measures in Organic Crop Production Systems

Weed control measures in organic crop production systems include

- Mechanical/physical control: this could involve mowing, hoeing, flaming, soil solarization, tilling or cultivation
- Planting of cover crops and mulching of soil surfaces can be done to smother weeds.
- Use of trap crops to help reduce weed population

3.4 Benefit of Organic Control Measures in Crop Production Systems

- Biodiversity conservation: absence of chemicals (nematicides, insecticides, fumigants, herbicides etc.) reduces broad-spectrum effects on beneficial fauna, microbial species and all soil life. Addition of various plant and animal derived organic materials enhances the soil food web and indirectly the above ground food web.
- Environmentally friendly: pest is controlled using natural products e.g. plant based oils or extracts to keep pest off without damaging or polluting the surrounding environment.

- Healthier Long-term effects: organic pesticides are typically effective for a longer period of time than chemical sprays.
- No pest resistance: chemical sprays and pesticides lose their effectiveness over time as the pest develops resistance but in using organic measures, pests are less likely to develop resistance since organic treatments are biologically based rather than artificially created.

SELF-ASSESSMENT

- List the control measures suitable for insects, diseases and weeds
- List and explain the benefits of organic pest control measures

4.0 CONCLUSION

Pest control measures in organic systems of crop production are obtained from natural sources or means rather than artificially created. This practice poses no harm to the ecosystem and good control is achieved as pests are less likely to develop any form of resistance given that the treatments provided are biologically based.

5.0 SUMMARY

Organic crop pest (insect, disease and weeds) control is achieved basically through adoption of natural control measures. Insects pest are controlled using the biological, cultural, mechanical, integrated pest management and the use of bio-pesticides. While disease control is achieved majorly through the use of resistant varieties, crop rotation, manipulation of cultural practices etc. Weed management methods in organic systems is by planting of cover crops, trap crops and adoption of mechanical methods by hoeing, mowing, tilling etc. Adoption of these systems of control is beneficial as it is environmentally friendly, safe and pests are unlikely to develop any form of resistance to the control measures used.

6.0 TUTOR MARKED ASSIGNMENTS

- i. List 4 control measures each for insects, diseases and weeds
- ii. List and explain 4 benefits of organic pest control measures

7.0 REFERENCES/ FURTHER READING

4 Benefits of Organic Pest Control- Do it Best. www.doitbest.com

Hmadttu Abdel and Farag El-Shafie 2019. Insect pest management in organic farming systems.
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MODULE 7: ORGANIC FOODS, ORGANIC STANDARDS, CERTIFICATION AND MARKET, BENEFITS OF CERTIFICATION OF ORGANIC PRODUCTS.

Unit 1: Organic Foods and Organic Standards

Unit 2: Certification and Market of Organic Foods, Benefits of Certification of Organic Products.

UNIT 1: ORGANIC FOODS AND ORGANIC STANDARDS

CONTENTS

- 1.0 Introduction
- 2.0 Objectives
- 3.0 Main content
 - 3.1 Organic foods
 - 3.2 Organic standards
- 4.0 Conclusion
- 5.0 Summary
- 6.0 Tutor marked assignments
- 7.0 References/ further reading

CONTENTS

1.0 INTRODUCTION

Organic foods are those produced or grown without the use of synthetic chemicals such as pesticides, fertilizers and does not contain genetically modified organisms. The process of organic crop production promotes ecological balance, biodiversity, conservation and recycling of resources. Organic livestock are produced without antibiotics or growth hormones, genetic engineering and ionizing radiation among other requirements while the crops are cultivated without using fertilizers made with synthetic ingredients conventional pesticides but ensures that cultivation practices that maintain or improve the physical, chemical and biological condition of soil and minimize soil erosion are carried out.

2.0 OBJECTIVES

- i. To know organic foods
- ii. To know the standards for organic foods

3.0 MAIN CONTENT

3.1 Organic Foods

These are foods produced or grown without the use of synthetic chemicals such as pesticides, fertilizers and does not contain genetically modified organisms. They are food sources that promote ecological balance, biodiversity, conservation and recycling of resources. In terms of chemical composition, it has 17% higher concentration of polyphenols compared to conventional grown crops, 69% higher concentration on other nutrients such as flavonols, phenolic acid and anthocyanins. It also has 69% higher

flavonones. Production of organic foods is mostly carried out by farmers who emphasize the use of renewable resources and the conservation of soil and water to enhance environmental quality for future generations.

3.2 Organic standards

Organic is a labeling term that indicates that the food or agricultural product has been produced following approved methods. The standards or requirements for organically produced food are:

3.3.1 Organic standards for livestock

- ❖ Organic meat, poultry eggs and dairy products come from animals that are given no antibiotics or growth hormones, mammalian or avian byproducts or other prohibited feed ingredients e.g. urea, manure or arsenic compounds.
- ❖ The livestock must be produced without genetic engineering, ionizing radiation or sewage sludge and they must be managed in a manner that conserves natural resources and biodiversity.
- ❖ They must be managed organically from the last third of gestation (mammals) or second day of life (poultry). They must be raised per animal health and welfare standards.
- ❖ The animals must be fed 100% certified organic feed (access to certified organic pasture for the entire grazing season for ruminants), except for trace minerals and vitamins used to meet the animals nutritional requirements.
- ❖ Animals must be allowed year round access to the outdoors except under specific conditions e.g. hash/ unfavorable weather conditions.
- ❖ Animals must be raised in a way that accommodates their health and natural behavior such that the animals have access to: shade for fresh air, clean dry bedding, clean drinking water, shelter from direct sunlight, outdoor for exercise etc.

3.3.2 Organic standards for food crops

- ❖ Organic food crops should be produced without using fertilizers made with synthetic ingredients or sewage sludge. Soil nutrients / fertility must be managed through rotations, cover crops and the application of plant and animal materials.
- ❖ Organic food crops should be produced without using conventional pesticides.
- ❖ The crops must be produced without using bioengineering or ionizing radiation.
- ❖ The farmer must select and implement tillage and cultivation practices that maintain or improve the physical, chemical and biological condition of soil and minimize soil erosion.

SELF-ASSESSMENT

- Explain organic standards.
- What are organic foods?
- List the organic standards for livestock and crop production

4.0 CONCLUSION

Organic standards for crops and livestock describe the specific requirements that must be met before its labeled or certified organic. In livestock production, animal production must be devoid of antibiotics, growth hormones, fed organic foods etc while crop production has to be devoid of chemicals e.g. synthetic fertilizer, pesticides, herbicides among other requirements.

5.0 SUMMARY

Organic foods produced or grown without the use of synthetic chemicals such as pesticides, fertilizers and does not contain genetically modified organisms. The practices involved promote ecological balance, biodiversity, conservation and recycling of resources. Organic standard is a requirement that needs to be followed in order for the food or agricultural product is labeled or termed organic. In livestock production some of the requirements include: non-usage of growth hormones, antibiotics, genetic engineering, ionizing radiation etc. while for the crop production no usage of chemicals e.g. pesticides, synthetic fertilizers, herbicides, sewage sludge etc.

6.0 TUTOR MARKED ASSIGNMENTS

- i. Define organic standards.
- ii. Define organic foods
- iii. List 4 organic standards each for livestock and crop production

7.0 REFERENCES/ FURTHER READING

Ann H. Bailer 2012. Organic Standards for Crop Production. Excerpts of USDA'S National Organic Program Regulations. National Sustainable Agriculture Information Service. A project of the National Center for Appropriate Technology.

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UNIT 2 CERTIFICATION AND MARKET OF ORGANIC FOODS, BENEFITS OF CERTIFICATION OF ORGANIC PRODUCTS

CONTENTS

- 1.0 Introduction
- 2.0 Objectives
- 3.0 Main content
 - 3.1 Certification of Organic Foods
 - 3.2 Benefits of Certification of Organic Products
 - 3.3 Market of Organic Foods
- 4.0 Conclusion
- 5.0 Summary
- 6.0 Tutor marked assignments
- 7.0 References/ further reading

CONTENTS

1.0 INTRODUCTION

Products are labeled or certified organic when it has been produced and processed in an ecologically sound manner. The label could differ depending on certification body but it can be taken as an assurance that the essential elements constituting an organic product have been met from the farm to the market. The certification process involves inspection of the organic farms, food companies by inspectors. These inspectors are also inspected by accreditation agencies to ensure that standard or quality is not compromised. When a product is certified as organic, a certificate and a trading schedule listing all the crops, livestock or products certified to trade as organic is issued.

2.0 OBJECTIVES

- i. To understand certification of organic foods
- ii. To know the procedures for certification of organic foods
- iii. To know the benefits of certification of organic products
- iv. To understand the marketing of organic foods

3.0 MAIN CONTENT

3.1 Certification of Organic Foods

Certified organic products are those which have been produced, stored, processed, handled and marketed in accordance with precise technical specifications (standards) and certified by a certification body. It means that for a product to be labeled organic, a government approved certifier inspects the farm where the food is grown to make sure the farmer is following all the rules necessary to meet organic standards i.e. product has been produced and processed in an ecologically sound manner. Companies that handle or process organic food before it gets to the supermarket or restaurant must be certified too. i.e. organizations working up and down the supply chain – from farmers, to packers, to food processors and organic retailers have to meet organic standards and prove it to the certification body.

3.3.1 Certification procedure

- Inspection: The organic farms and food companies are thoroughly inspected at least once a year. Information obtained is recorded to show that the standards are being met.
- Once the farms and companies are certified to have met the organic standards, they are issued a certificate and a trading schedule. It lists all the crops, livestock or products certified to trade as organic. This certificate acts like a passport and is necessary to prove the organic status of the goods when they are sold on.
- Products imported must carry a organic certificate as well as certificate of import.
- Organic certification also involves inspection of organic farm or food company inspectors. This is carried out by accreditation bodies

3.2 Benefits of Certification of Organic Products

Certification of organic products has the following benefits:

- i. It helps producers and handlers receive premium prices for their products
- ii. Producers and handlers can access fast growing local, regional and international markets
- iii. Certification supports local economies
- iv. It provides opportunity to access additional funding and technical assistance
- v. Certification enhances marketing of products to consumers

3.3 Market of Organic Foods

Once certified a product is certified as organic, a certificate and a trading schedule listing all the crops, livestock or products certified to trade as organic is issued. This certificate acts like a passport and is necessary to prove the organic status of the goods when they are sold. The price of organic food is generally higher than that of conventionally grown food. Depending on the product, season, and demand the price of organic food can be anywhere from 10% below to more than 100% above that of conventional grown produce. Manufacturers can use organic seals when marketing their products. Products that contain

100% organic ingredients may be labeled 100% organic. Generally most purchased organic foods are fruits and vegetables as they account for over 70% of organic food purchases.

SELF-ASSESSMENT

- What is certification of organic food production?
- List the procedures of certification of organic foods
- List the benefits of certification of organic foods
- Explain the marketing of organic products

4.0 CONCLUSION

Certification that a product is organic confirms that the product has been produced and processed in an ecologically sound manner. A certificate alongside a trading schedule listing all the crops, livestock or products certified / labeled to trade as organic is issued. When the products are sold, the label proves the organic status of the goods.

5.0 SUMMARY

Certified organic products are those which have been produced, stored, processed, handled and marketed in accordance with precise technical specifications (standards) and certified by a certification body. The process involves inspection of the organic farm, food companies by inspectors who are also checked by accreditation agencies. Once certified a product is certified as organic, a certificate and a trading schedule listing all the crops, livestock or products certified to trade as organic is issued. This certificate acts like a passport and is necessary to prove the organic status of the goods when they are sold. Certification of organic products is beneficial as it helps producers and handlers receive premium prices for their products and also helps them access fast growing local, regional and international markets among other benefits.

6.0 TUTOR MARKED ASSIGNMENTS

- i. What is certification of organic foods
- ii. List the procedures of certification of organic foods
- iii. List the benefits of certification of organic foods
- iv. Explain the marketing of organic products

7.0 REFERENCES/ FURTHER READING

Soil Association 2019. What are Organic Standards? www.soilassociation.org/our-standards/what-are-organic-standards

United States Department of Agriculture (USDA).2019. Benefits of Organic Certification. USDA Agricultural Marketing Service.www.ams.usda.gov

MODULE 8: ADVANTAGES AND DISADVANTAGES OF ORGANIC AGRICULTURE.

Unit 1: Advantages and Disadvantages of Organic Agriculture.

CONTENTS

- 1.0 Introduction
- 2.0 Objectives
- 3.0 Main content
 - 3.1 Advantages of organic agriculture
 - 3.2 Disadvantages of organic agriculture
- 4.0 Conclusion
- 5.0 Summary
- 6.0 Tutor marked assignments

7.0 References/ further reading

UNIT 1 ADVANTAGES AND DISADVANTAGES OF ORGANIC AGRICULTURE.

CONTENTS

1.0 INTRODUCTION

The practice of organic agriculture was developed as a response to the environmental harm caused by the use of synthetic chemicals used in conventional agriculture. Organic agriculture in addition to enhancing environmental health also helps recycles animal waste, produce healthier and tastier food etc. The benefits are counter balanced by higher food costs for consumers and low yields often recorded.

2.0 OBJECTIVES

- i. To know the advantages of organic agriculture
- ii. To know the disadvantages of organic agriculture

3.0 MAIN CONTENT

3.1 Advantages of Organic Agriculture

- i. Food produced is healthier to consume because they are free of pesticides, herbicides and synthetic fertilizers.
- ii. Foods are better tasting as they contain no additives that can alter the taste. Studies have shown that organic foods have healthier chemicals and mineral salts that increase internal value and quality.
- iii. Higher levels of antioxidants: organic fruits and vegetables contain 40% more antioxidants thus reducing the risk of heart diseases, stroke and cancer.
- iv. Promotes healthy family
- v. Protects the environment: as it uses manures instead of fertilizers, crop rotation instead of monoculture, weeding for herbicides and nitrogen fixing plants instead of nitrogenous fertilizers. Thus the environment is protected from pollution and contamination
- vi. Promotes improved animal reproduction: research has shown that animals that feed on organic foods reproduce more compared to their non-organic food eating counterparts.
- vii. Supports local economy: purchasing organic foods support local farmers and their organic farmers thus creating more jobs.
- viii. It is cheaper: buying organic food may be expensive but it saves cost (health care) as it prevents occurrence of major and minor diseases.

3.2 Disadvantages of Organic Agriculture

- i. They are hard to find because only few local farmers are adopting organic farming and also because it takes twice as long to produce organic crops than the conventional.
- ii. They do not last long because they do not contain preservatives.
- iii. They are expensive i.e. the price of organic food is generally higher than that of conventionally grown food because a lot of manual labour is involved.
- iv. They do not have a strong promotion
- v. They need a lot of efforts i.e. its labour intensive
- vi. Yields of organic crops have been found to be about 25% lower overall than conventional grown crops

SELF-ASSESSMENT

- List the advantages of organic agriculture
- List the disadvantages of organic agriculture

4.0 CONCLUSION

The use of natural resources rather than agrochemicals e.g. fertilizers, pesticides, herbicides etc. for animal and crop production ensures healthy food and environment.

5.0 SUMMARY

Organic agriculture has certain advantages, some of which include environmental conservation, tastier and healthier food rich in antioxidants, improved local economy etc. these benefits or advantages are counter balanced by low yields, expensive food, quick spoilage due to lack of preservatives, labour intensive practices etc.

6.0 TUTOR MARKED ASSIGNMENTS

- i. List 5 advantages of organic agriculture
- ii. List 5 disadvantages of organic agriculture

7.0 REFERENCES/ FURTHER READING

Crystal Ayres 2015. 14 meaningful advantages and disadvantages of organic foods

Raoul Adamchack 2019. Organic farming. www.britamica.com

MODULE 9: BASIC PRACTICES IN ORGANIC CROP PRODUCTION: PRE-PLANTING OPERATIONS (SITE SELECTION, LAND PREPARATION), PLANTING OPERATIONS (SEED SELECTION, PLANTING) AND POST-PLANTING OPERATIONS (PEST, DISEASE AND WEED MANAGEMENT, HARVEST AND STORAGE). .

Unit 1: Pre-planting Operations (site selection, land preparation)

Unit 2: Planting Operations (seed selection, planting) and Post-planting Operations (pest, disease and weed management, harvest and storage).

UNIT 1: PRE-PLANTING OPERATIONS (SITE SELECTION, LAND PREPARATION)

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1.0 Introduction

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| 2.0 | Objectives |
| 3.0 | Main content |
| | 3.1 Site Selection |
| | 3.2 Land Preparation |
| 4.0 | Conclusion |
| 5.0 | Summary |
| 6.0 | Tutor marked assignments |
| 7.0 | References/ further reading |

CONTENTS

1.0 INTRODUCTION

The choice of land for cultivation is a critical decision farmers should make as it determines the success or failure of the crop. Site selection plays an important role in sustainable agriculture as it considers the climatic, hydrological and geological factors that influence crop productivity. In organic agricultural crop production cultivation site selected is such that is devoid of heavy metals or hazardous materials to ensure its status of being certified organic.

2.0 OBJECTIVES

- To understand site selection in organic cropping systems
- To know the factors to be considered in selecting sites for organic crop production

3.0 MAIN CONTENT

3.1 Site Selection

Site selection: certain factors are considered in choosing a site for organic crop production.

- The climatic conditions (temperature, rainfall sunshine hours) as well as extreme weather conditions are considered in selecting a site where the crop will be cultivated.
- Soil factors such as texture, color, organic matter, pH and fertility levels are put into consideration. These can be improved or altered through the addition of organic fertilizers such as compost or manure.
- Site selection also puts into consideration crops suitable/adaptable to that environment.

- Biotic factors within the environment are also considered. They are the things within the ecosystem such as plants, animals, bacteria, fungi etc. the prevalence of certain diseases or pest as this decides the choice of crops i.e. weather tolerant or resistant to such pest.
- Site selected must be free of prohibited substances (heavy metals and other hazardous materials), must have distinct defined boundaries and buffer zones in order to prevent any unintended application of prohibited substance.
- Topography i.e. the slope or elevation chosen for cultivation should be such that is suitable for the crop

3.2 Land Preparation

Land preparation: the land clearing, tillage as well as cultivation methods should be chemical (pesticide, herbicide and synthetic fertilizer) free so as to encourage the soils natural ecosystem to thrive. Land preparation involves incorporation of manures or ash so as to boost the organic matter content of the soil. The cleared vegetation on the land to be cultivated should be used as mulch materials on the cultivated field.

SELF-ASSESSMENT

- What is site selection?
- What are the factors to be considered during site selection?
- Briefly explain land preparation in organic systems.

4.0 CONCLUSION

Organic cropping systems ensure that pre-planting activities carried out are devoid of chemical usage. Site selection takes into cognizance the climate, soil, topography etc and land preparation chemical free.

5.0 SUMMARY

The site selection in organic cropping systems considers factors such as; climate, topography, biotic factors, crop adaptability, soil etc. land preparation is mostly manual and free of chemical free so as to encourage the soils natural ecosystem to thrive. The cleared vegetation on the land to be cultivated is often used as green manure or mulch materials on the cultivated field

6.0 TUTOR MARKED ASSIGNMENTS

- i. What is site selection?
- ii. What are the factors to be considered during site selection?

- iii. Briefly explain land preparation in organic systems.

7.0 REFERENCES/ FURTHER READING

Jennifer Chait 2018. Organic farmland requirements. Thebalancesmb.com/organic-farmland-requirements-2538086

Anonymous 2019. Vegetable resources. aggiehorticulture.tamu.edu/vegetable/guides/organic-vegetable-production-guide/organic-crop-production-requirements

Anonymous 2019 The organic farmer. The magazine for sustainable agriculture in Kenya. Theorganicfarmer.org/articles/seed-selection-inimportant-derivng-planting-season

UNIT 2: PLANTING OPERATIONS (SEED SELECTION, PLANTING) AND POST-PLANTING OPERATIONS (PEST, DISEASE AND WEED MANAGEMENT, HARVEST AND STORAGE).

CONTENTS

- 1.0 Introduction
- 2.0 Objectives
- 3.0 Main content
 - 3.1 Seed selection
 - 3.2 Planting
 - 3.3 Post-Planting Operations (pest, disease and weed management, harvest and storage).
- 4.0 Conclusion
- 5.0 Summary
- 6.0 Tutor marked assignments
- 7.0 References/ further reading

CONTENTS

1.0 INTRODUCTION

Selection of good seeds is vital as it helps good germination as well as growth of strong and healthy crops. Planting of selected seeds at recommended spacing reduces competition between plants for growth resources and ensures development of vigorous plants. The control of pest, disease and weeds in organic cropping systems is achieved through crop rotation, mechanical/physical control, mulching, field sanitation, integrated pest management etc. Crops are harvested at maturity and stored properly to avoid losses

especially chemical usage is not allowed in the system. Storage at low temperatures and relative humidity's increase the life span of stored products.

2.0 OBJECTIVES

- i. To determine pest, disease and weed management methods
- ii. To understand harvesting and storage of produce in organic systems

3.0 MAIN CONTENT

3.1 Seed Selection

Seed selection: good quality seeds are essential for the growth of strong and healthy crops which can resist diseases or even drought. Healthy seeds (free from seed borne diseases) can be acquired from trusted seed sources. Small, shriveled and broken seeds contain less food for the developing seedling therefore should be removed so as to get stronger and healthier seedlings.

Seeds with desirable traits e.g. greater adaptability, pest and disease resistance, high yielding ability etc. should be selected. Seed selection may also be based on acceptability or on market preferences because of size, color, number of grains and other desirable traits.

3.2 Planting

Planting: seeds should be planted at the recommended spacing to allow good root establishment/development so each plant can have access to enough sunlight and nutrients. The water requirement/needs of the crop to be planted are important for good growth and development.

3.3 Post-Planting Operations (pest, disease and weed management, harvest and storage).

3.3.1 Pest, disease and weed management

Pest and disease management in organic cropping systems are achieved through a number of ways some of which are:

- Crop rotation i.e. growing crops in sequence is adopted so as to break insect pest, disease or weed cycles.
- Field sanitation to remove or rogue disease vectors, weed seeds and habitat for pest organisms
- Adoption of good cultural practices e.g. selecting disease and pest resistance varieties.

- Mechanical or physical pest control such as introduction of predators or parasites of the pest species
- Mulching with full biodegradable materials to control weeds.
- Application of non synthetic biological botanical or mineral inputs.
- Intercropping can help reduce the problem of weeds especially in mixtures with legumes as they spread and cover the soil surface thus smothering weeds.
- Integrated pest management where different control measures as discussed above are combined to achieve pest control.

3.3.2 Harvesting

Harvesting is done as soon as they ripen/mature to avoid losses/reduction in quality especially as storage chemicals i.e. preservatives are not used.

3.3.3 Storage

Harvested produce are stored by maintain; low temperatures and relative humidity for grains, sprinkling of diatomaceous earth on grains and sanitize/seal, load, aerate and monitor (SLAM)

SELF-ASSESSMENT

- What type of seeds should be considered for planting?
- Why is it needful to plant at recommend spacing?
- List the pest control measures in organic cropping systems.
- Briefly explain how produce are harvested and stored in organic cropping systems

4.0 CONCLUSION

Post planting operations in organic systems adopt the usage of natural means of pest control and storage methods rather than the use of chemicals. Methods of pest control include the use of resistant varieties, field sanitation, crop rotation etc. while storage is ensured at low temperatures and relative humidity.

5.0 SUMMARY

Good seeds should be selected and planted at the recommended spacing to allow good root establishment/development so each plant can have access to enough sunlight and nutrients. Pest and disease management in organic cropping systems are achieved through a number of ways some of which are; crop rotation, use of resistant varieties, non-synthetic biological botanical or mineral inputs etc. Harvesting is done when the crop matures and the produce are stored at low temperature and humidity levels.

6.0 TUTOR MARKED ASSIGNMENTS

- i. What type of seeds should be considered for planting?
- ii. Why is it needful to plant at recommend spacing?
- iii. List 5 pest control measures in organic cropping systems.
- iv. Briefly explain how produce are harvested and stored in organic cropping systems

7.0 REFERENCES/ FURTHER READING

Anonymous 2019. The Organic Farmer. The magazine for sustainable Agriculture in Kenya. theorganicfarmer.org/articles/seed-selection-imporatance-during-planting-season.

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Ron Heiniger 2017. Post harvest handling of organic grains

MODULE 10: PEST (INSECTS, NEMATODES, WEEDS, VERTEBRATES AND PATHOGENS) MANAGEMENT METHODS IN ORGANIC CROP PRODUCTION. USE OF BOTANICALS AND BIO-INTENSIVE INTEGRATED PEST MANAGEMENT

Unit 1 Pest (insects, nematodes, weeds, vertebrates and pathogens) Management Methods in Organic Crop Production.

Unit 2 Use of Botanicals and Bio-intensive Integrated Pest Management

UNIT 1 PEST (INSECTS, NEMATODES, WEEDS, VERTEBRATES AND PATHOGENS) MANAGEMENT METHODS IN ORGANIC CROP PRODUCTION.

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- 1.0 Introduction
- 2.0 Objectives
- 3.0 Main content
 - 3.1 Insect Control in Organic Crop Production
 - 3.2 Nematode Control in Organic Crop Production
 - 3.3 Weed Control in Organic Crop Production
 - 3.4 Vertebrate Control in Organic Crop Production
 - 3.5 Pathogen Control in Organic Crop Production
- 4.0 Conclusion
- 5.0 Summary
- 6.0 Tutor marked assignments
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CONTENTS

1.0 INTRODUCTION

Crop pests are species of organisms that reduce the availability, quality or value of crop plants. The pests include insects, nematodes, weeds, pathogens and vertebrates. To reduce pest numbers to an acceptable threshold in organic systems, measures other than chemical usage is adopted to achieve control such as biological and cultural measures. Different pest could have control measures peculiar to them alone or applicable to another pest. e.g. insect pest and disease control can be achieved through crop rotation and adoption of resistant varieties. Weed and vertebrae pest control could be achieved basically through mechanical means. Management of crop pest in organic systems of crop production ensures that whatever strategy is adopted, no harm is caused to the environment.

2.0 OBJECTIVE

- i. To determine methods of pest (insect, nematode, weed, vertebrate and pathogen) control in organic crop production systems.

3.0 MAIN CONTENT

3.1 Insect Control in Organic Crop Production

Insect pest control inorganic systems are achieved primarily through biological means where predators or parasites of the pest species are introduced. Other strategies employed

include crop rotation and selection of pest resistant crop varieties. Mechanical control measures can be adopted through hand picking of insects or trapping (light traps, sticky traps, sweep nets, pitfall traps etc.) is carried out. Where there is serious infestation, pheromones might be used to disturb mating cycles

3.2 Nematode Control in Organic Crop Production

Nematodes in organic crop production systems can be controlled through sanitation and soil solarization (increasing soil temperatures). Usage of nematode free plants is also essential to avoid nematode problems. Plants and soils from infested sites should not be transferred to healthy sites. Biological control can also be employed where plant parasitic nematodes are controlled using other organisms such as bacteria, fungi, predatory nematodes or other vertebrates. Companion crops with nematicidal root exudates can be used alongside susceptible crops. Nematodes could also be controlled by flooding as oxygen supply is cut off, the nematodes die of oxygen starvation. The use of organic mulches and crop rotation could also serve as a control measure for nematodes.

3.3 Weed Control in Organic Crop Production

The primary weed control measures in organic systems are achieved through cultural and mechanical methods of control.

- Cultural control measures include;
 - Crop rotation to disrupt weed cycles
 - Use of mulches and cover crops to smother or suppress weeds
 - Timely tillage
 - Use of trap crops to reduce weed population
 - Intercropping with legumes which can serve as cover crops to smother weeds
- Mechanical weed control

Mechanical weed control involves tillage of soil. Pre-plant tillage such as plowing, disking and ridging. These tillage practices can help reduce the rate and spread of certain perennial weeds, kill emerged weeds seedlings and bury weeds/weed seeds below the germination zone. Mowing of weeds helps weed control by preventing weed seed production and mowing can kill or suppress weeds.

3.4 Vertebrate Control in Organic Crop Production

Vertebrate pest include birds, mammals, reptiles etc that cause damage to agricultural crops. Control measures include;

- Using scaring devices and exclusion nets for birds

- Baiting and trapping of the animal pest
- Exclusion fencing as well as adoption of good animal husbandry
- Habitat manipulation
- Environmental sanitation by keeping the area trash and debris free as well as removal of overgrown vegetation
- Building pest proof structures

3.5 Pathogen Control in Organic Crop Production

In organic systems, pathogens are basically controlled through cultural means by

- Crop rotation
- Planting resistant varieties
- Manipulating time of planting
- Alter environment of host to suppress infestation

SELF-ASSESSMENT

- List the major pest in organic crop production system
- Briefly discuss suitable control measures for the pest listed above

4.0 CONCLUSION

Pest control in organic crop production systems ensure that no chemical is used as it is priority to maintain a healthy environment. The major pest in this system are; insect, pathogens, vertebrates, pathogens etc and these can be controlled using different measures some of which include: crop rotation, sanitation, soil solarization, mechanical and biological control measures etc.

5.0 SUMMARY

Crop pests are species of organisms that reduce the availability, quality or value of crop plants. The pests include insects, nematodes, weeds, pathogens and vertebrates. Insect pest control inorganic systems are achieved primarily through biological means where predators or parasites of the pest species are introduced, nematodes can be controlled through sanitation and soil solarization (increasing soil temperatures), weed control is achieved through mechanical methods as well as good cultural practices, vertebrates using scaring devices and exclusion nets for birds and pathogens through cultural means e.g. crop rotation, use of resistant varieties etc

6.0 TUTOR MARKED ASSIGNMENTS

1. List 5 major pest in organic crop production system
2. Briefly discuss suitable control measures for the pest listed above

7.0 REFERENCES/ FURTHER READING

S.R. Gowen 2019. FAO. Alternate strategies for nematode control towards sustainable agriculture

William Curran 2005. Weed management in organic cropping systems. PennState Extension

UNIT 2 USE OF BOTANICALS AND BIO-INTENSIVE INTEGRATED PEST MANAGEMENT

CONTENTS

- 1.0 Introduction
- 2.0 Objectives
- 3.0 Main content
 - 3.1 Botanicals: Definition, examples, use in pest control
 - 3.2 Bio-intensive integrated pest management
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1.0 INTRODUCTION

The use of botanicals and bio-intensive integrated pest management in organic agriculture is due to the fact that they are considered relatively environment friendly beneficial insects are less likely to be killed as the case in synthetic pesticide usage. Botanicals are natural plant products/extracts used in pest control while the bio-intensive integrated pest management relies on a range of preventive tactics and biological control to keep pest populations within acceptable limits. The use of botanicals is advantageous as it degrades more rapidly than chemical pesticides although cost of production and high frequency of application make s the practice expensive.

2.0 OBJECTIVES

- To understand the use of botanicals as pest control measures in organic crop production systems.
- To understand bio-intensive integrated pest management in organic crop production systems.

3.0 MAIN CONTENT

3.1 Botanicals: Definition, examples, use in pest control

Botanicals are natural plant products used in pest control. Their use in organic agriculture is due to the fact that it degrades more rapidly than most chemical pesticides and are therefore considered relatively environment friendly, it is less likely to kill beneficial insects than synthetic pesticides with longer environmental retention. The use of botanicals is however more expensive than conventional pesticides because of high cost of production and frequent application given its ability to degrade within a very short time. Examples of plants that possess pesticidal properties include: *Pyrethrum*, neem, rotenone, *Artemisia* sp, *Hyptis* sp, Garlic etc.

There are different types of bio pesticide extracts some of which include:

- Essential oils: these are oils extracted mainly from aromatic plants. They have repellent, insecticidal, anti-feedants, growth inhibitors, oviposition inhibitors, ovicides and growth reducing effects on a variety of insects.
- Alkaloid: these are natural substances that act as pesticides through their insecticidal, larvicidal and anti-feedant activities e.g. pyridine alkaloids extracted from *Ruta chalepensis* leaves has larvicidal effects on *Spodoptera littoralis*.
- Flavonoids: plant extracts effective against feeding insects and herbivores. They offer protection to plants by influencing insect behavior, growth and development. e.g flavonoids from *Tephrosia purpuria* showed insecticidal properties on *Callosobruchus maculatus* grubs.
- Glycosides: these express insect growth inhibitory activities and are also effective against storage insect pest as fumigants.
- Esters and fatty acids: they have larvicidal, insecticidal and repelling effects on pest

The modes of action of the bio-pesticides listed above are:

- Repellants: act by keeping insect pest away and thus protecting the crop
- Feeding deterrents/anti-feedants: they inhibit feeding or disrupt insect feeding by rendering the treated materials unattractive or unpalatable.
- Toxicity: these are toxic and cause death of pest when ingested (stomach poison). Toxic biopesticides can act as fumigants.
- Growth retardants and development inhibitors: these show deleterious effects on the growth and development of insects, reducing the weight of larva, pupa and adult stages and lengthening the developmental stages. It can also act by reducing the survival rates of larvae and pupa as well as adult emergence.

- Sterility/reproduction inhibitors: this acts by interfering with the reproductive potential of sexually reproducing organisms leading to temporal or permanent sterility. The effect of this bio pesticide can also be expressed by preventing maturation of the young to a sexually functional adult stage

3.2 Bio-intensive Integrated Pest Management

This refers to pest prevention through natural, non chemical means. Besides the use of pesticides, other means of control such as crop rotation, introduction of native predators of pest, introduction of sterile males or reintroduction of natural, disease-fighting microbes into plants or soil. Additionally, pest management is based on an understanding of the pest ecology by, accurately diagnosing the nature and source of pest problems, and then relies on a range of preventive tactics and biological control to keep pest populations within acceptable limits. This practice of pest control is beneficial because there is reduced chemical input cost, reduced on-farm and off-farm environmental impacts and more effective and sustainable pest management.

SELF-ASSESSMENT

- Define botanicals
- List 5 plant extracts and briefly explain their mode of action
- Briefly discuss bio-intensive integrated pest management

4.0 CONCLUSION

Pest control in organic systems is basically achieved through the use of botanicals and bio-intensive integrated pest management systems as they have been proven to be sustainable and have no negative environmental impacts.

5.0 SUMMARY

Botanicals are insecticides naturally occurring chemicals extracted or derived from plants sources e.g. neem, garlic, Artemisia, Hyptis etc. These plants contain chemicals such as flavonoids, alkaloids, glycosides, they act as repellants, anti feedants, growth retardants, reproduction inhibitors etc. Bio-intensive integrated pest management is a pest management strategy which seeks to understand the pest ecology and ensures it remains

within normal limits by adopting a range of preventive tactics and biological pest control measures.

6.0 TUTOR MARKED ASSIGNMENTS

- I. What are botanicals?
- II. List 5 plant extracts and briefly explain their mode of action
- III. Briefly discuss bio-intensive integrated pest management

7.0 REFERENCES/ FURTHER READING

Paravatha Reddy P. 2012. Recent advances in crop protection: Bio-intensive Integrated Pest Management. pp 223-244

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Wafaa M. Hikal, Rowida S. Baeshen and Hussein A.H. Said-Al Ahl 2017. Botanical insecticide as simple extractives for pest control, cogent Biology 3: 1